National Aeronautics and
Space Administration

Space Technology Mission Directorate: Space Technology Overview

Presented by:
Dr. Michael Gazarik,
NASA Associate Administrator for
Space Technology Mission Directorate

May 30, 2013

www.nasa.gov/spacetech

Challenges for Deep Space Exploration

Communication

Environment Control & Life Supporting Systems

Power Generation & Storage

Logistics

Navigation

Manufacturing In Space & For Space

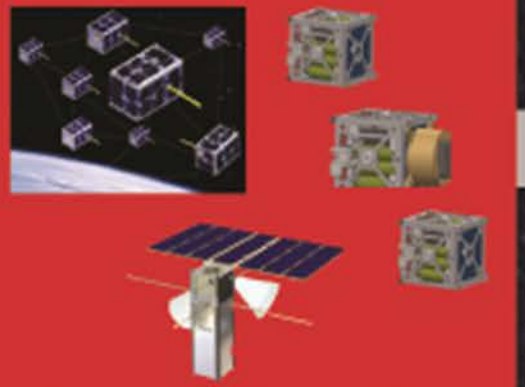
Entry, Descent & Landing

Radiation Mitigation

Propulsion

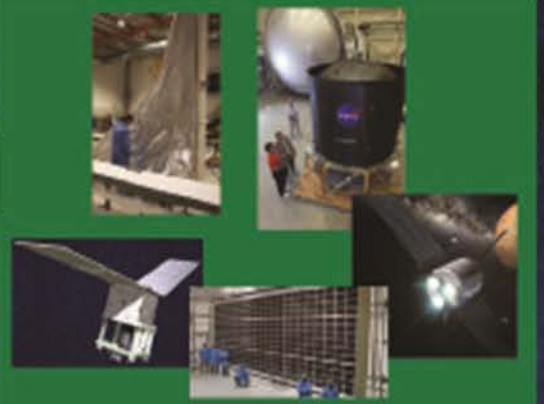
Trends in Space Technology

Small Spacecraft



Entry, Descent & Landing

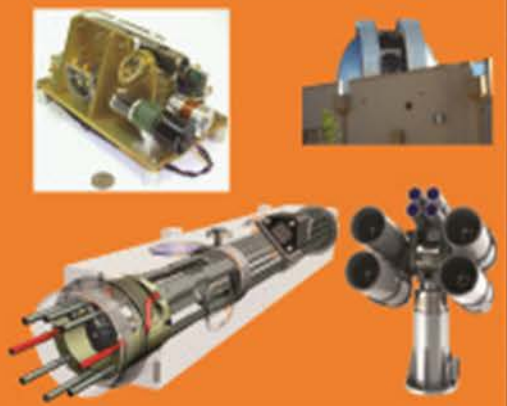
Propulsion



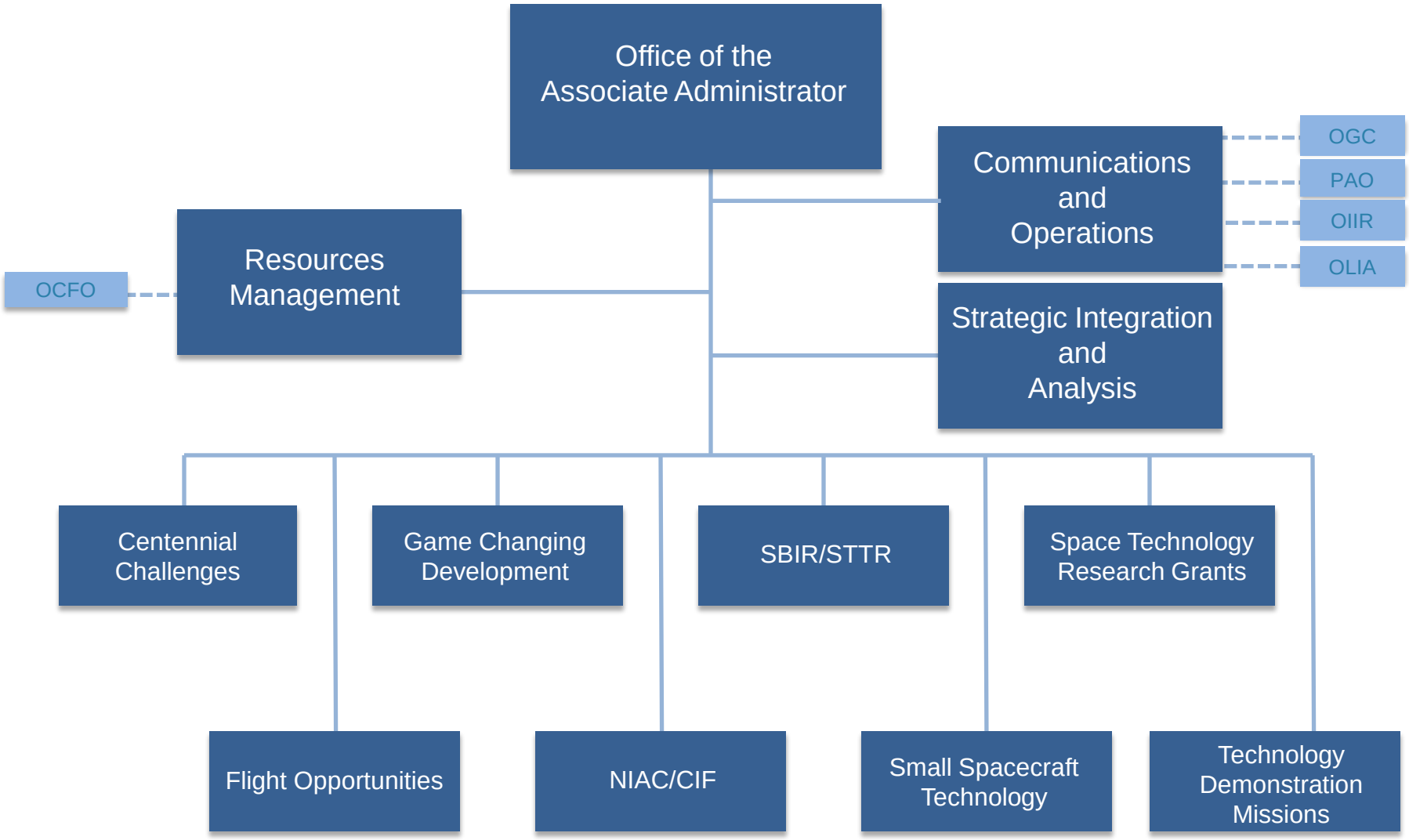
Robotics

Manufacturing

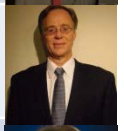
Communications



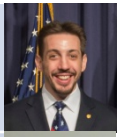
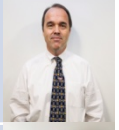
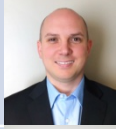
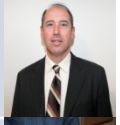
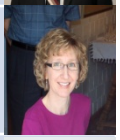
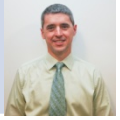
Space Technology Mission Directorate Organization



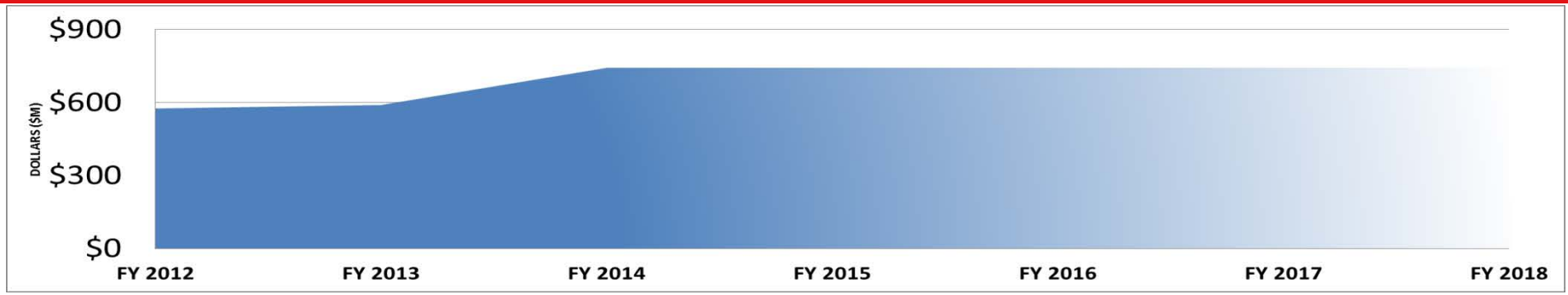
STMD Senior Leadership

Associate Administrator	Michael Gazarik	
Deputy Associate Administrator for Management	Dorothy Rasco	
Deputy Associate Administrator for Programs	James Reuther	
Director for Communications and Operations / Chief of Staff	G. Michael Green	
Director for Resource Management	Robert Carver	
Director for Strategic Integration and Analysis	Prasun Desai	
Senior Technical Officer	Harry Partridge	
Office Manager	Evelyn Vidal-Roles	
Executive Officer	Natalie Simms	

Program Executives

Program	Program Executive	
Center Innovation Fund & NIAC	Jay Falker	
Centennial Challenges	Larry Cooper	
Flight Opportunities	LK Kubendran	
Game Changing Development Program	Tibor Balint	
SBIR/STTR	Rich Leshner	
Small Spacecraft Technology Program	Andy Petro	
Space Technology Research Grants	Claudia Meyer	
Technology Demonstration Missions	Randy Lillard	

STMD FY 2014 President's Budget



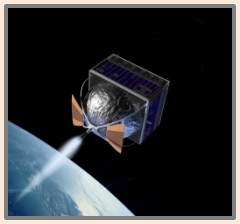
	Budget Authority ($M)	FY 2014	Notional FY 2015	FY 2016	FY 2017	FY 2018
	FY 2014 President's Budget Request	**743**	**743**	**743**	**743**	**743**
OCT	Partnership Developments and Strategic Integration	**34**	**34**	**34**	**35**	**35**
Space Tech Mission Directorate	SBIR and STTR	**186**	**192**	**200**	**212**	**212**
	Crosscutting Space Tech Development	**278**	**256**	**213**	**241**	**244**
	Early Stage Innovation	62	62	62	62	62
	Flight Opportunities	15	15	15	15	15
	Small Spacecraft	17	17	17	17	17
	Game Changing Development	76	73	68	70	71
	Technology Demonstration Missions	107	89	51	77	79
	Exploration Technology Development	**244**	**260**	**295**	**255**	**252**
	Game Changing Development	70	74	79	83	83
	Technology Demonstration Missions	175	186	216	173	169

Space Technology Portfolio

Transformative & Crosscutting Technology Breakthroughs

Game Changing Development (ETD/CSTD)

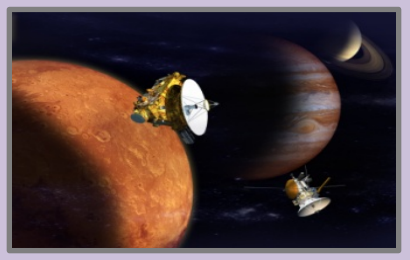
Technology Demonstration Missions (ETD/CSTD)



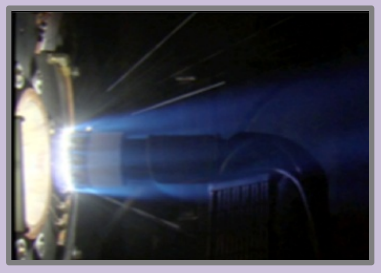
Small Spacecraft Technologies (CSTD)

Pioneering Concepts/ Developing Innovation Community

Space Technology Research Grant (CSTD)



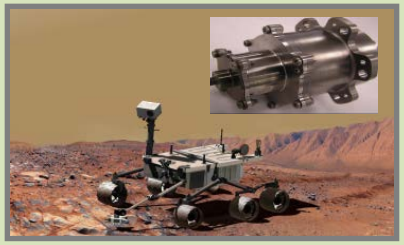
NASA Innovative Advanced Concepts (NIAC) (CSTD)



Center Innovation Fund (CSTD)

Creating Markets & Growing Innovation Economy

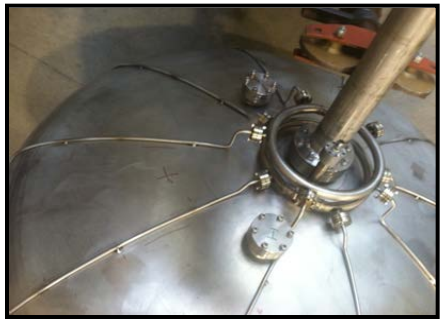
Centennial Challenges Prize (CSTD)



Small Business Innovation Research & Small Business Technology Transfer (SBIR/STTR)

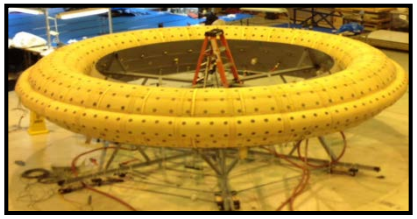
Flight Opportunities Program (CSTD)

New Hardware in Advancing Space Technology



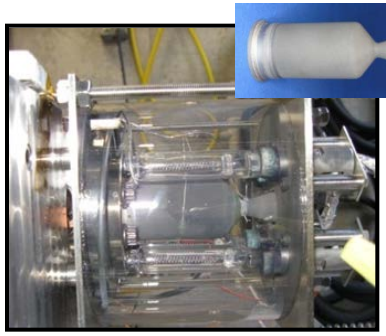
Cryogenic tank

Composite Strut Structural Testing



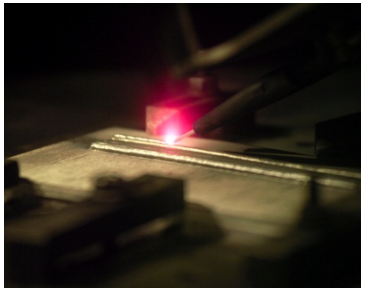
Low Density Supersonic Decelerator Proof Test

MSL heat shield with instrumentation

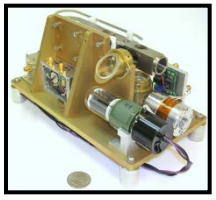


Green Propellant 22N thruster

Telerobotic Systems

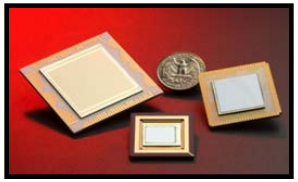


Additive Manufacturing

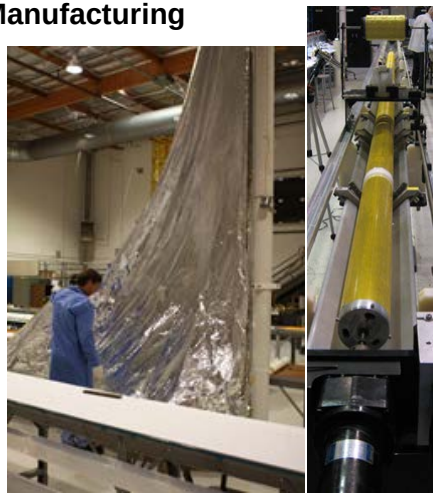


Deep Space Atomic Clock

Inflatable Re-entry Vehicle Experiment



BIRD focal plane arrays



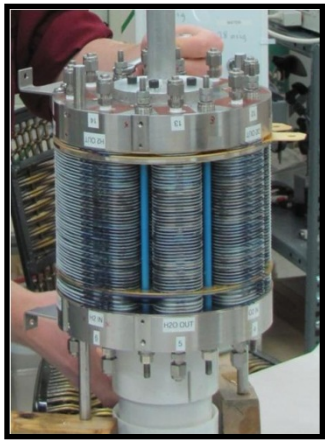
Solar Sail and Boom Fab

Exoskeleton

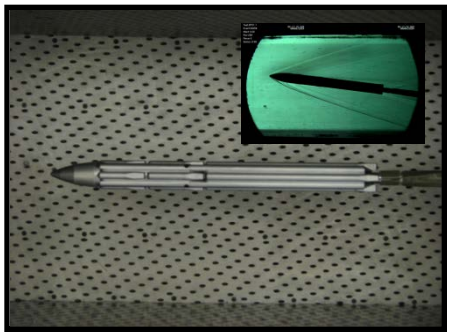
Game Changing Technology

X1 or Exoskeleton will improve life on Earth and in space

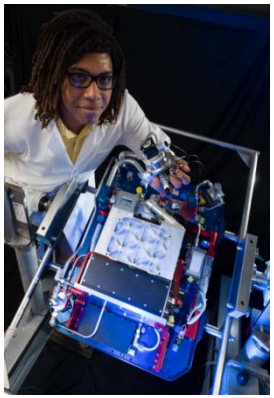
Arrival and testing of 2.4m precursor tank, the largest out-of-autoclave tank fabricated in the world



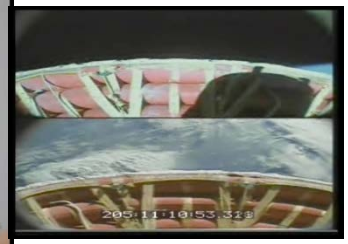
Space Power Systems First build of flight-like fuel cells



SWORDS model for wind tunnel testing at NASA MSFC

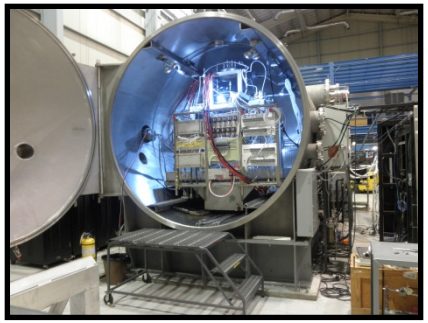


Next Gen Life Support Engineer Marlon Cox, with one of the Variable Oxygen Regulators



Launch of IRVE-3 – successful suborbital test of 3m HIAD

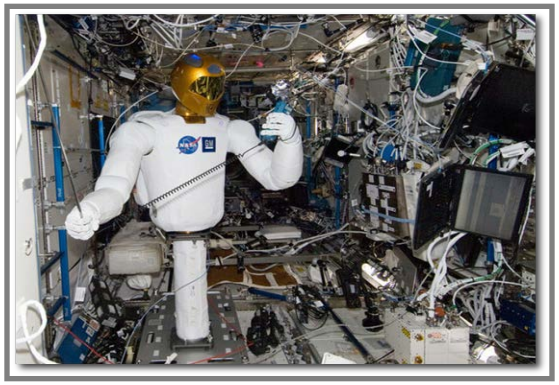
Successful test of a hands-free jet pack



Nuclear Systems delivered the Fission Power System Technology Demonstration Unit (TDU) Reactor Simulator

Technology Demonstration and Testing

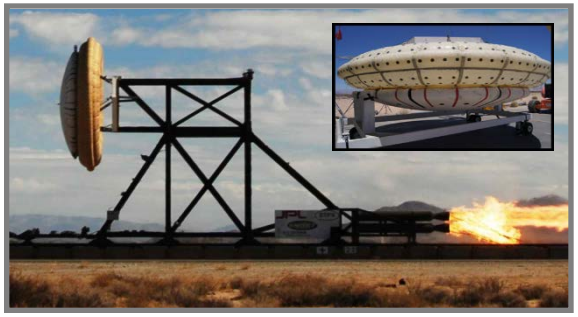
Mike Fossum with Smart SPHERES checkout



R2 using air flow meter

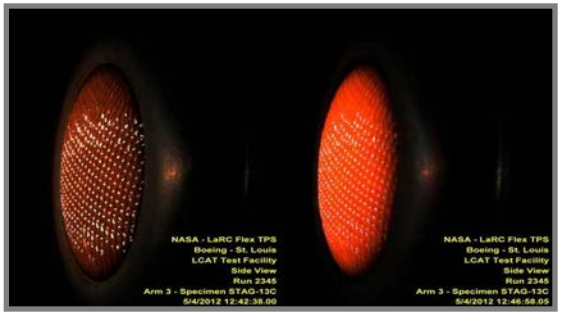
Reduced Liquid Hydrogen boil off test

ARC Jet Testing

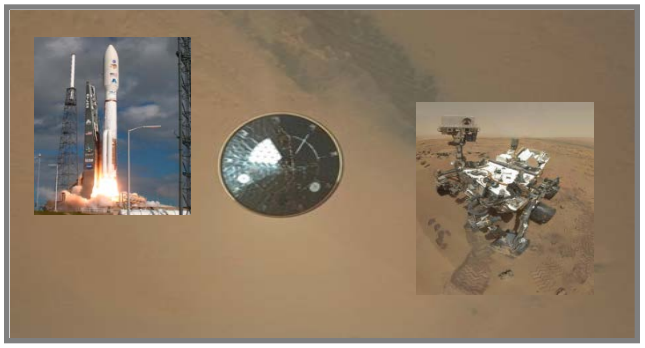


Low Density Supersonic Decelerator Sled Test

K10 rover deploying polyimide film

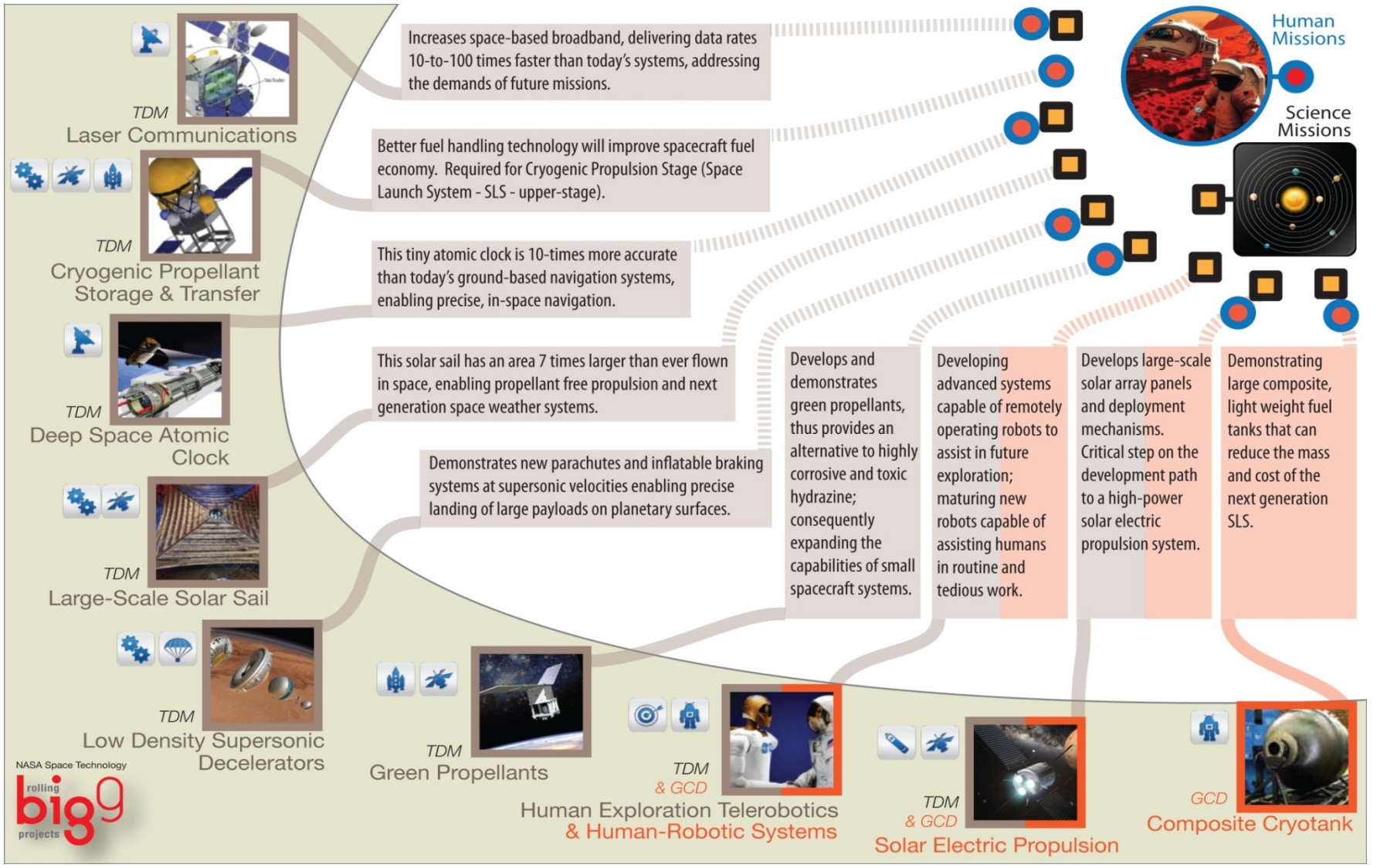


LCAT Stagnation Test (50 W/cm2)

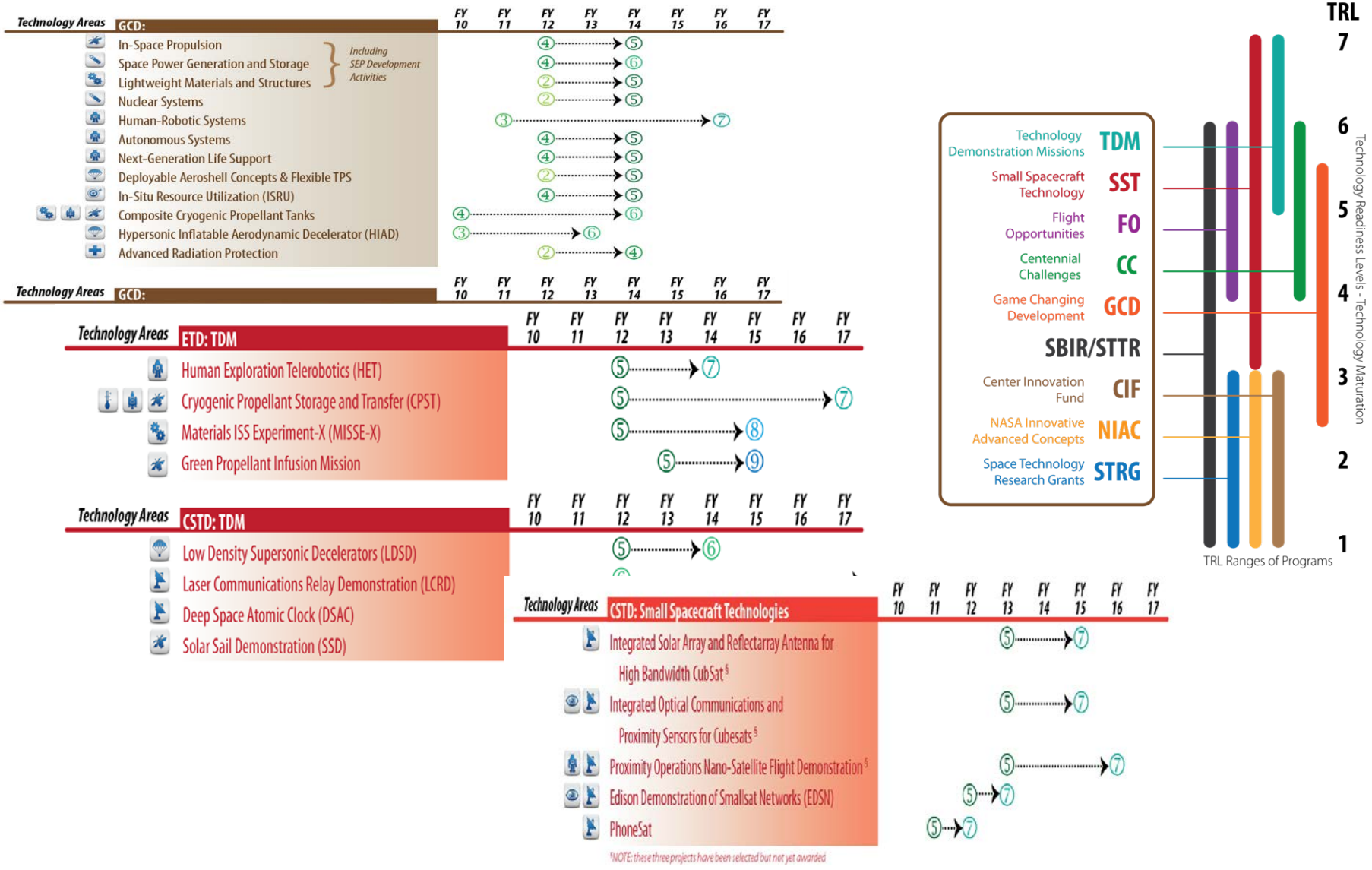


MSL Launch and MEDLI measurements successfully completed

FY2014 Big Nine

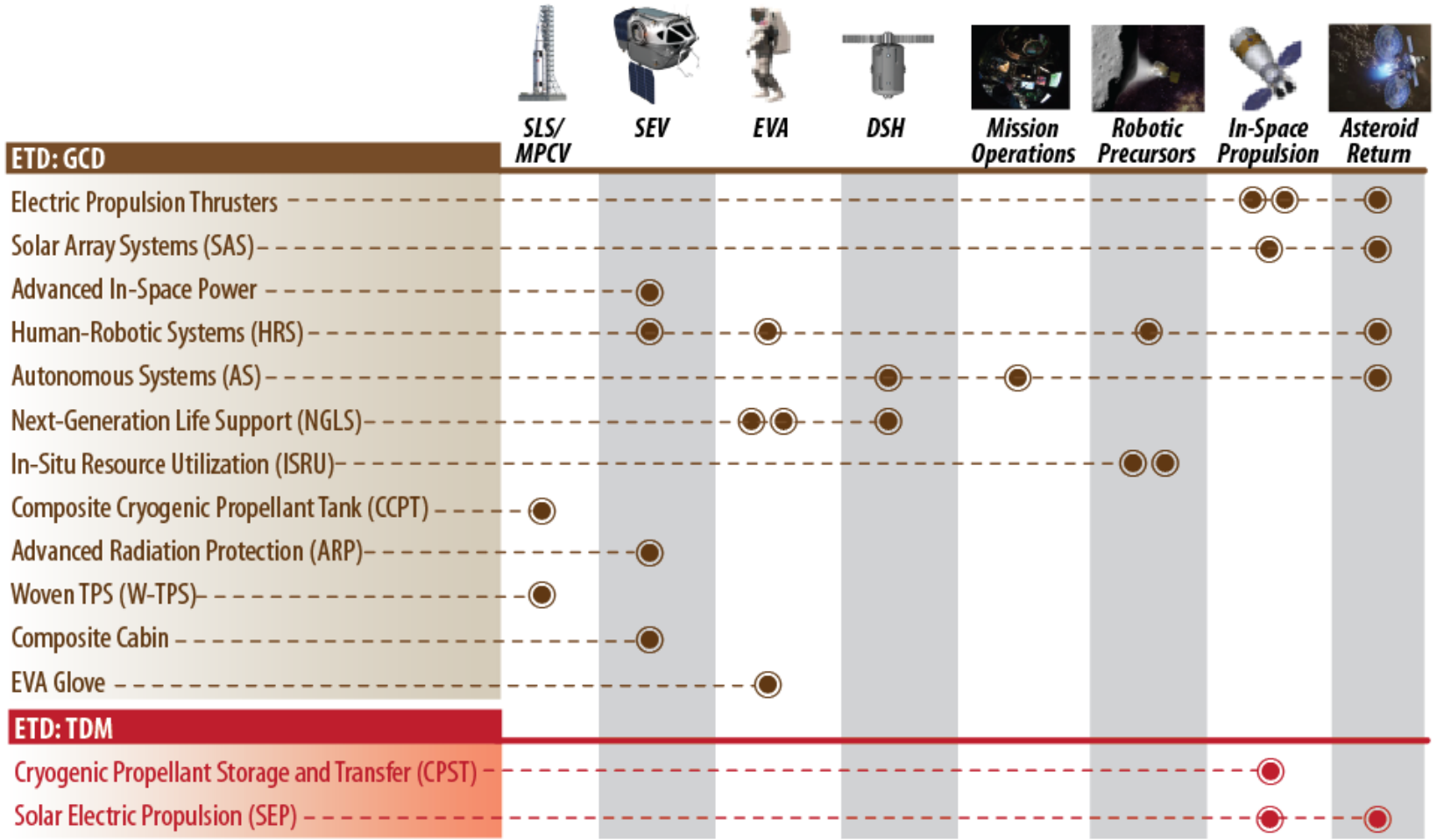


Portfolio Approach



Exploration Technology Development

Infusion



Space Technology
Major Events & Milestones

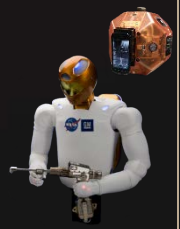
2012

HIAD
IRVE 3

Telerobotics

MEDLI

2013



Telerobotics

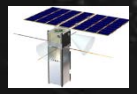
PhoneSat

Edison Demo
SmallSat

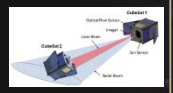
2014

Solar
Sail

Telerobotics



ISARA



OCSD

Supersonic
Inflatable
Aerodynamic
Decelerator

2015

CPOD

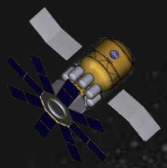
Atomic
Clock

Green
Propellant

Supersonic
Inflatable
Aerodynamic
Decelerator

2016

2017



Cryogenic
Propellant

**SEP Demo
Mission**

2018

Laser
Communications

Future Planning

Space Tech Role in Agency Asteroid Strategy

Early Stage programs will foster innovation regarding:

- Asteroid detection, characterization and mitigation for planetary defense and asteroid retrieval mission target selection
- Asteroid proximity operations and resource utilization techniques

Game Changing will complete high power SEP tech development:

- Advanced solar array systems
- Advanced magnetic shielded Hall thrusters
- Power processing units (PPUs)

Technology Demonstration Missions will develop, test and demonstrate the SEP system as part of the retrieval mission:

- 30kW – 50 kW advanced solar arrays
- Magnetically shielded Hall thrusters & Power Processing
- Xenon propellant tanks

Additional Asteroid Retrieval funding in FY2014 will cover:

- Flight hardware solar array procurements
- Hall thruster engineering development units
- Design of Xenon propellant tanks

Alignment Strategy

2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022

Asteroid Detection, Characterization & Selection Segment

SST

PS-2

Enhanced ground assets & Initial candidates

GEO-hosted payload detection

Final target selection

Asteroid Redirection Segment

THIS SEGMENT TIMELINE NOTIONAL- SUBJECT TO CHANGE AS MISSION CONCEPT EVOLVES

Mission Launch & SEP Demo

Asteroid Rendezvous & Capture

Asteroid Maneuver to cis-lunar

Orion & SLS Crewed Asteroid Exploration Segment

First flight of Orion

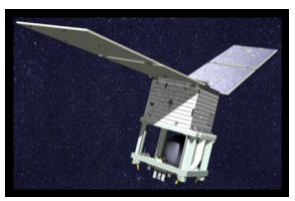
EM-1: Un-crewed Orion test beyond the Moon

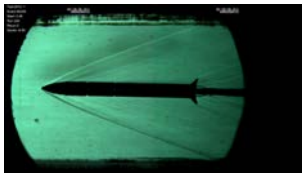
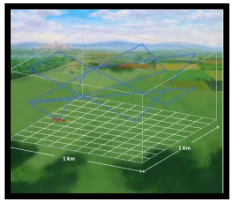
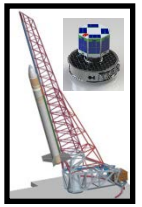
EM-2: Crew on Orion to the asteroid

Collaborations with Other Government Agencies

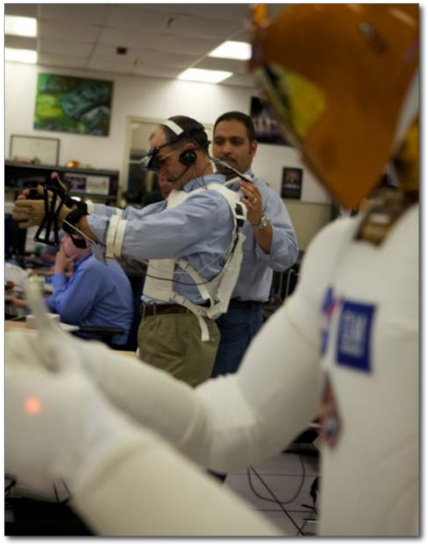
Currently, significant engagements include:

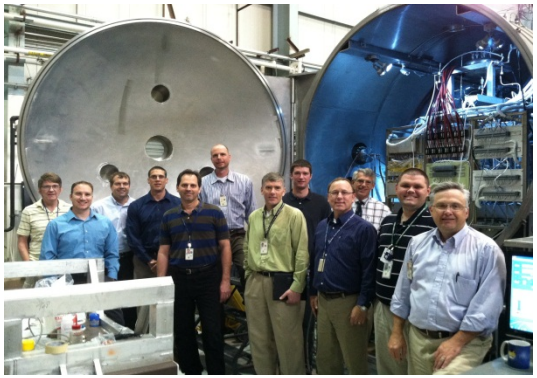
- Green Propellant Infusion Mission partnership with **Air Force Research Laboratory** propellant and rideshare with **DoD's Space Test Program (STP)**
- Solar Sail Demonstration partnership with **NOAA** and rideshare with **Air Force**
- Soldier-Warfighter Operationally Responsive Deployer for Space (SWORDS) low-cost nano-launch system with **Army**
- UAS Airspace Operations Prize Challenge coordinated with **FAA**
- Working with the **USAF Operationally Responsive Space Office (ORS)** for launch accommodations for the Edison Demonstration of Smallsat Networks (EDSN) mission.
- Partnership for Ohio's first hydrogen generating fueling station with **Greater Cleveland Regional Transit Authority** to power city bus
- Partnership with **DARPA** on "Next Generation Humanoid for Disaster Response"
- In discussion with **Department of Veteran Affairs** for a collaborative project with "Exoskeleton" from our Human Robotics Systems Program




Working Together to Innovate






National Aeronautics and
Space Administration
NASA
QUESTIONS??
More Information at:
www.nasa.gov/spacetech